[7590-01-P]
DD-14-05

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION

William M. Dean, Director

In the Matter of	)	
	)	
Exelon Generation Company, LLC	)	
	)	
Braidwood Station, Units 1 and 2	)	Docket Nos. STN 50-456, 50-457
	)	License Nos. NPF-72, NPF-77
Byron Station, Unit Nos. 1 and 2	)	Docket Nos. STN 50-454, 50-455
	)	License Nos. NPF-37, NPF-66

DIRECTOR'S DECISION UNDER 10 CFR 2.206

I. Introduction

By e-mail to Mr. R. W. Borchardt dated April 20, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12130A318), Mr. Barry Quigley (the petitioner) filed a petition under Title 10, "Energy," of the *Code of Federal Regulations* (10 CFR) 2.206, "Requests for Action under This Subpart." The petitioner requested that the U.S. Nuclear Regulatory Commission (NRC or the Commission) immediately shut down Braidwood Station, Units 1 and 2, and Byron Station, Unit Nos. 1 and 2, until all turbine building (TB) high-energy line break (HELB) concerns were identified and those important to safety were corrected. The bases for the requests were:

- An adequate supply of combustion air for the emergency diesel generators (EDGs) is threatened because the combustion air can be diluted with steam. Although the combustion air is drawn from an air shaft (not the TB), it is also the same air shaft that supplies ventilation for the EDG room. Under certain conditions, the ventilation damper

alignment is such that steam that enters the EDG room from the ventilation exhaust can back flow into the inlet air shaft. From there it can be drawn into the engine, potentially starving the engine of air.

- The effects of high temperature in the engineered safeguards features (ESF) switchgear (SWGR) rooms on the protective relaying setpoints have not been evaluated. The concern is that high temperatures could alter the setpoints such that protective actions occur under normal loading conditions.
- The current method of analysis for TB HELB uses a "lumped volume" approach wherein the mass and energy (M&E) of the ruptured line mixes instantly with the entire volume before flowing into the areas of concern. Because this substantially reduces the energy flow, it does not always give conservative results. For example, the petitioner's preliminary assessment using the subdivided volume feature in GOTHIC showed that the structural limits on the block wall between the ESF SWGR rooms would be substantially exceeded.
- There has been no structured and detailed review of the licensing requirements for HELB.

The Petition Review Board met to discuss the request for immediate action on May 4, 2012, and initially decided to deny that request because the licensee had completed an operability evaluation (OE) and found the equipment addressed in the petition was operable but degraded. On May 14, 2012, the PRB notified the petitioner that the request for immediate action was denied. The petitioner participated in an initial teleconference with the PRB on May 16, 2012, to provide the PRB with additional explanation and information in support of the petition. After considering the additional information received, on August 23, 2012, the NRC

staff informed the petitioner by letter (ADAMS Accession No. ML12167A336) that his request for immediate shutdown was denied and that the issues in the petition were being referred to the Division of Safety Systems and the Division of Engineering in the Office of Nuclear Reactor Regulation (NRR) for review. The denial of the immediate shutdown request was based on the NRC staff's then-current knowledge of licensee actions on the HELB issue, including a review of licensee operability evaluations, which found that the equipment was operable but degraded, PRB discussions with the Resident Inspector staff at Byron and Braidwood Stations concerning the OEs, and information in the licensee's corrective action program documents indicating that the equipment operability issues in the petition had been addressed.

Although the PRB concluded that immediate shutdown of the plants was unwarranted, the PRB determined that additional information was needed. By letter dated August 2, 2012 (ADAMS Accession No. ML12208A338), the NRC staff requested that the licensee, Exelon Generation Company, LLC (Exelon, the licensee), provide a voluntary response to the issues raised in the petition. By letter dated August 31, 2012, Exelon provided its voluntary response consisting of a response letter and 7 attachments. The response letter and Attachment 1 are publicly available (ADAMS Accession No. ML12249A063) and Attachments 2 through 7 are proprietary, however Exelon provided the petitioner access to the entire response, including the proprietary attachments.

The PRB held a second teleconference with the petitioner on November 15, 2012, to allow the petitioner to address some PRB questions regarding the petitioner's preliminary assessment of the TB HELB using the GOTHIC subdivided volume feature, which provided results that substantially exceeded the block wall structural limit. During this telelconference, the PRB requested additional information regarding the basis for the issues identified in the

petition. Specifically, the PRB requested, and the petitioner agreed to provide, specific information pertaining to the modeling he performed.

The transcripts of the May 16, 2012, teleconference (ADAMS Accession No. ML12145A633) and the November 15, 2012, teleconference (ADAMS Accession No. ML12347A354), were treated as supplements to the petition and are available for inspection in the NRC's Public Document Room (PDR) located at O1F21, 11555 Rockville Pike (first floor), Rockville, Maryland 20852. Publicly available documents created or received at the NRC are accessible electronically through ADAMS in the NRC Library at http://www.nrc.gov/reading-rm/adams.html. Persons who do not have access to ADAMS or who encounter problems in accessing the documents located in ADAMS should contact the NRC's PDR reference staff by telephone at 1-800-397-4209 or 301-415-4737 or by e-mail to pdr.resource@nrc.gov.

The NRC sent a copy of the proposed director's decision to the petitioner and to Exelon for comment on June 18, 2014. The staff did not receive any comments on the proposed directors decision.

II. Discussion

The petitioner raised several concerns related to potential consequences of TB HELBs to support his request for immediate shutdown of the Braidwood and Byron plants. After a brief background discussion of HELB nonconformance issues at Byron and Braidwood (Section II.A), each of the petitioner's concerns is addressed in the subsequent sections.

A. Background

On June 23, 2011 (ADAMS Accession No. ML111790030), Exelon submitted a license amendment request (LAR) for measurement uncertainty recapture (MUR) power uprates for the

Byron and Braidwood Stations. In an August 25, 2011 (ADAMS Accession No. ML11255A332), supplement to the LAR, Exelon identified nonconservative assumptions in the TB HELB calculations for those breaks that could potentially result in higher temperatures and pressures in certain auxiliary building (AB) room locations. Exelon stated that it had evaluated these discrepancies in OEs and concluded that there was reasonable expectation of operability for the Class 1 E and safety-related equipment in the identified rooms. Exelon further stated that it intended to modify the plant physical configuration such that the OE would no longer be required.

By letter dated September 19, 2011 (ADAMS Accession No. ML112231574), the NRC staff accepted the LAR for review. The NRC staff stated, however, that satisfactory disposition of the known nonconformance with the turbine HELB licensing basis would be required prior to implementation of the MUR uprate should the NRC staff approve the proposed license amendment request.

B. Emergency Diesel Generator Operability

The petitioner's first concern is that steam from a nonsafety-related piping failure in the TB can travel to the safety-related AB through ventilation openings in the common wall between the auxiliary and turbine buildings. Under certain conditions, the ventilation damper alignment is such that steam can enter the EDG room from the ventilation exhaust and can back flow into the inlet air shaft and dilute the EDG combustion air supply with steam. From there it could be drawn into the EDGs, potentially starving them of combustion air.

The structures, systems, and components affected are the EDGs. There are two EDGs per unit, one for each ESFs division. The EDGs provide an independent emergency source of power in the event of a complete loss of offsite power. The EDG supplies all of the electrical

loads which are required for reactor safe shutdown either with or without a loss-of-coolant accident. If the EDGs cannot perform their safety function, the reactor would not be able to be maintained in a safe shutdown condition without restoration of offsite electrical power or another alternating current (AC) source.

The information provided in Attachment 2 of the licensee's August 31, 2012, voluntary response showed that the licensee had performed a technical evaluation of high-temperature and high-humidity combustion air on the operation of the EDGs. In the technical evaluation, the licensee assumed that the steam/air mixture would enter the EDG room from the room ventilation exhaust path. The mixture would then enter the EDG room ventilation supply duct and would flow past the room supply air fan and into the supply air mixing box. The mixture would then flow past the mixing box filters and into the main air intake plenum, where the EDG combustion air intake is located. The licensee assumed a maximum steam/air temperature in the main air intake plenum of 200 degrees Fahrenheit (°F) and 70 percent relative humidity before the EDG start. The licensee also assumed that a TB HELB would coincide with an EDG start demand.

The licensee stated in the August 31, 2012, voluntary response that the EDGs at Byron and Braidwood Stations are Cooper-Bessemer model KSV 20-cylinder diesel engines. Under a normal loaded operation, the intake-air constant-pressure turbocharging is provided by a turbocharger that is driven by the EDG exhaust gas. The intake air for combustion in the engine cylinders is drawn from the main air intake plenum through the air intake filter and air intake silencer; it then enters the EDG turbocharger. The air is pressurized by the turbocharger, and its temperature is elevated by the heat of compression from the turbocharger. The higher-temperature air then travels to an intercooler to lower the temperature before entering the manifold to charge each engine cylinder.

When the EDG is started, the turbocharger is inoperative because there is insufficient exhaust gas produced to drive the turbocharger during an EDG start. At this point, the diesel engine behaves like a normally aspirated engine. Therefore, the intake air exiting the turbocharger would be comparable to air at atmospheric pressure and temperature. The intercoolers would have only minor cooling effects because no heat has been added to the air by turbocharger compression.

Theoretically, approximately 14.5 pounds (lb) of air are required for the combustion of one lb of fuel oil. When a diesel engine operates at a light load, the actual air-fuel ratio is several times greater than the theoretical value of 14.5 lb. According to Cooper-Bessemer, the minimum excess air above the stoichiometric requirement at 100 percent load is 40 percent. The engine's technical data sheet states that the fuel consumption at 100 percent load (5500 kW) is 2744.5 lb per hour (hr). The estimated fuel consumption at no load is approximately 120 lb/hr. These consumptions are based on an air temperature of 90 °F. The licensee therefore determined that the actual air-fuel ratio when the EDG operates at no load would be much greater than the theoretical value of 14.5 lb.

The licensee stated that when an EDG receives a start signal, the EDG room supply air fan also receives a start signal. When the EDG starts to use combustion air, air flows from outside into the air plenum, and mixes with the higher temperature and higher humidity air from the HELB in the vicinity of the combustion air intake. This will rapidly lower the temperature and humidity of the combustion air used by the EDG. Also, the EDG room supply air fan would draw the higher temperature and higher humidity air from the plenum and discharge it into the room where it will then exit the room through the ventilation exhaust openings through which it came.

Ignition of the diesel fuel depends on the temperature of the compressed air-fuel mixture and sufficient oxygen. The increased intake-air temperature will encourage ignition of the diesel fuel. The increased temperature and humidity conditions from the steam will result in less dense air to support diesel fuel combustion. Increasing the intake-air temperature from the 90 °F standard condition to the assumed temperature of 200 °F and 70 percent humidity will reduce air density from 0.072 lb per cubic foot (lb/ft^3) to 0.060 lb/ft^3. This is a decrease in air density of approximately 17 percent. The licensee determined that because the amount of air available during an EDG start is many times greater than the minimum stoichiometric requirement necessary to support fuel combustion, this decrease in air density will have little effect on an EDG start.

Once fuel combustion initiates to accelerate the engine, the EDG exhaust will accelerate the turbocharger and the intake air supply will increase because of the turbocharger operation. The outside air entering the plenum to provide the intake air would quickly bring the intake air quality back to ambient conditions. As a result there would be no steady-state higher intake-air temperature or higher humidity to cause a reduction of engine horsepower or increase in fuel consumption or exhaust-gas temperature. Therefore, the licensee concluded that the EDGs would be operable to perform their safety functions.

As described above, the flow path for the steam is indirect, and the steam will mix with the air in the TB, the EDG room, the EDG room ventilation air supply duct, the supply air mixing box, the intake-air plenum, and the EDG intake-air ductwork. When the EDG and the EDG room ventilation fan start, the percentage of steam in the combustion air will be small and will only last for a short duration because the room ventilation fan and the EDG intake air will immediately draw outside into the air plenum to replace the higher temperature and higher

humidity air that is used by the EDG and removed by the room ventilation fan. Therefore, based on the above information, the NRC staff's knowledge of and experience with EDGs, and engineering judgment, the staff concludes that there is reasonable expectation of EDG operability.

C. High Temperature in the Engineered Safety Feature Switchgear Rooms

The second issue raised in the petition is that the effects of high temperature on the protective relaying setpoints in the ESF SWGR rooms have not been evaluated. The petitioner was concerned that high temperatures could alter setpoints such that protective actions occur under normal loading conditions. To address this concern, the NRC staff performed an independent review of the licensee's OE provided in Attachments 3 and 4 to its voluntary response dated August 31, 2012, to determine if the ESF rooms' protective relays should be considered operable using guidance in Inspection Manual Part 9900, "Operability Determination."

The ESF rooms are connected to the TB by a rolling door and a postulated HELB in the TB can cause higher temperature in the ESF SWGR rooms that could alter or change the protective relay setpoints. In Attachment 4 to its voluntary submittal dated August 31, 2012, the licensee provided its evaluation that determined the maximum peak temperature in ESF rooms caused by TB HELB will be 170 °F based on its existing HELB analysis using the Kitty-6 model. The normal operating temperature in the ESF SWGR rooms is 108 °F.

In Attachment 3 to the voluntary response dated August 31, 2012, the licensee used the above maximum peak temperature of 170 °F (caused by HELB in the TB) for a maximum time of two hours to evaluate the ESF SWGR room protective relays and relay setpoint operability at

Braidwood Station, Units 1 and 2, and Byron Station, Unit Nos. 1 and 2. Based on this evaluation, the licensee determined there is a reasonable expectation of ESF SWGR room protective relaying operability.

During discussions with the NRC on October 18, 2012, the licensee provided additional clarification that the licensee's OEs (11-005 for Byron and 11-006 for Braidwood) are based on a single-failure assumption (i.e., failure of one fusible link within a ventilation fire damper for one ESF SWGR room). This single failure is assumed to result in all the equipment in one ESF SWGR room/train becoming non-functional and non-recoverable. The opposite train located in the other ESF SWGR room is still operable up to 170 °F.

The NRC staff reviewed the licensee's GOTHIC model temperature graphs for the ESF SWGR rooms, which were provided in Attachments 6 and 7 of Exelon's voluntary submittal dated August 31, 2012. These temperature graphs reflect temperature values of 295 °F for the ESF Division 2 room and 260 °F for 1200 seconds (sec) in the ESF Division 1 room with an upward trend. These values exceed the 170 °F values used in the licensee's operability evaluations (11-005 for Byron and 11-006 for Braidwood). During a teleconference with the licensee on October 22, 2012, the NRC staff asked the licensee to explain the GOTHIC model temperature values reflected in Attachments 6 and 7 of its August 31, 2012, submittal. The licensee explained that the primary purpose of these specific GOTHIC model runs was to optimize the pressure results in the ESF SWGR room walls by perturbing the model to intentionally consider higher temperatures that would provide maximum pressure. For example, heat sinks in the ESF SWGR rooms were deliberately not included in the GOTHIC model runs to intentionally keep temperature higher and optimize the pressure. The temperature results would be lower with the addition of heat sinks in the test runs of GOTHIC model for peak

temperature. The licensee stated that it has not performed GOTHIC model runs specifically for the peak temperature results. Attachment 3 of the licensee's August 31, 2012, voluntary submittal states that if the final GOTHIC model predicted higher temperatures, it would affect the licensee's current OEs 11-005 and 11-006. The licensee stated that when it completed the analyses of the GOTHIC model for peak temperatures, it would review and revise OEs 11-005 and 11-006, if the OEs were still needed. The NRC staff's review of the TB HELB analysis associated with the power increase from the Braidwood and Byron Stations' MUR power uprate, which is documented in the safety evaluation for MUR uprate (ADAMS Accession No. ML13281A000) revealed that the peak temperatures of 170 °F were not exceeded; therefore, the NRC staff confirmed that the OEs did not need revision.

For the reasons discussed above, the NRC staff determined that temperature results in the licensee's GOTHIC model runs for the ESF SWGR rooms in the licensee's August 31, 2012, voluntary submittal, do not reflect realistic temperatures for use in predicting ESF SWGR room protective relaying operability. Therefore, the NRC staff used the ESF SWGR room's peak temperature value of 170 °F, which is based on the results of the licensee's current licensing basis Kitty-6 HELB model, to evaluate whether there is a reasonable expectation that the ESF rooms' protective relaying will continue to be operable.

In Attachment 3 of its August 31, 2012, voluntary response, the licensee identified the following safety-related design functions of equipment and components related to the 4kV ESF SWGR room protective relays:

1. Initiating a Feed Breaker trip on a 4kV Bus Degraded Undervoltage (timed). This safety-related design function is supported by Bus Degraded Voltage Relays located in the ESF 4kV SWGR rooms and is described in the Byron and Braidwood Stations'

Technical Specification (TS) 3.3.5, “Loss of Power (LOP) Diesel Generator (DG) Start Instrumentation.”

2. Initiating Load Breaker trip and EDG start on a 4kV Bus Undervoltage. This safety-related design function is supported by LOP Undervoltage Relays located in the 4kV ESF SWGR rooms and is described in Byron and Braidwood Stations’ TS 3.3.5, “Loss of Power (LOP) Diesel Generator (DG) Start Instrumentation.”
3. Operation of breakers supplying safety-related loads.
4. Isolation of electrical fault.

For the safety design functions identified above related to the ESF SWGR room protective relays, the licensee used a maximum peak temperature of 170 °F for two hours and determined that the equipment and components in the ESF SWGR rooms would be reasonably expected to perform their design function during a TB HELB abnormal event transient.

The licensee’s evaluation provided in Attachment 3 of the licensee’s August 31, 2012, voluntary response, stated that Nuclear Logistics, INC (NLI) qualified various components, including relays for the ESF SWGR rooms, from a temperature range of 240 °F to 320 °F for a minimum duration of four days, as described in the plant EQ binder EQ-BB-093. Therefore, the tested conditions for the components in the ESF SWGR rooms envelop the HELB event maximum temperature of 170 °F for a 2-hour duration in the ESF SWGR rooms.

The licensee in Attachment 3 of its voluntary response dated August 31, 2012, generically evaluated ESF SWGR room protective relays and their setpoints. The licensee’s evaluation determined that the 4kV ESF SWGR rooms’ protective relaying uses magnetic and induction-based overload relays that are not temperature-sensitive.

Based on its review of the above information, the NRC staff concludes that the ESF SWGR rooms' protective relays are qualified to perform their safety design functions for TB HELB-related maximum peak temperature of 170 °F in the ESF SWGR rooms. In addition, the redundant train in the other ESF SWGR room will be available based on the single-failure assumption. Therefore, the staff finds that the licensee's OEs provide reasonable expectation of operability of the ESF SWGR rooms' protective relays.

D. Structural Limits on the Block Wall Between the ESF Switchgear Rooms

The third concern raised in the petition was that the differential pressure (DP) load applied on the ESF SWGR rooms' block walls because of the M&E release from applicable TB HELBs would exceed the structural capacity of the walls.

In its August 31, 2012, voluntary response, the licensee provided OEs which include computational evaluations, using the GOTHIC computer software, for operability/functionality of the ESF SWGR masonry unreinforced block walls, located in the AB at Elevation (EL) 426'-0", when considering the M&E release from TB HELBs. The licensee stated that the HELB effect was not previously accounted for in the evaluation of these block walls. The licensee also stated that additional work was required to finalize the GOTHIC model. Subsequently, the final GOTHIC model was reviewed by the NRC staff and documented in the safety evaluation of the Braidwood and Byron Stations' MUR power uprate (ADAMS Accession No. ML13281A000) as discussed in Section F, below.

The petitioner states that the KITTY-6 analysis for the TB HELB uses a "lumped volume" approach which does not give conservative results. The petitioner claimed that his preliminary

GOTHIC analysis with subdivided volumes showed that the structural limits on the block wall between the ESF SWGR rooms were substantially exceeded.

The licensee, in Attachment 2 of Attachment 6 to its August 31, 2012, voluntary response, provided a detailed evaluation specific to the SWGR block walls located in the AB at EL 426'-0". The licensee considered the effects of the differential pressure caused by the TB HELB on the masonry block walls. The temperature effect caused by a HELB on the steel columns supporting the block wall and their associated components was not accounted for in these block wall operability evaluations. Attachment 7 to the licensee's August 31, 2012, voluntary response shows that the temperature can reach approximately 295 °F. On October 16, 2012, the NRC held a teleconference with the licensee in reference to the HELB temperature effect on the block wall steel columns. The licensee stated that the steel in the SWGR rooms are wrapped in three-hour-rated fire wrap and, therefore, the temperature effects are very small for the applicable time frames. In addition, the licensee stated that it would initiate a corrective action to document the issue and implement follow-up actions as required. The licensee issued action request (AR) report No. 01427699. The AR shows that the block wall is a three-hour-rated fire barrier and the steel columns are covered with fireproofing material. The fire temperature is at 1000 °F in the first five minutes and gets to 1925 °F in three hours. The licensee, in AR report No. 01427699, determined that the fireproofing material will be sufficient to keep the steel columns from experiencing any negative effect from the HELB because the event duration is shorter and the temperature is considerably lower than that of the fire. From its review of the voluntary response, the NRC staff also notes that the heatup transient is assumed to end at two hours, at which time operator action is credited to restore

ventilation. Based on the above, the NRC staff finds the licensee's response acceptable regarding the HELB temperature effects on the steel columns supporting the block wall.

In Attachment 2 to its August 31, 2012, voluntary submittal, the licensee determined that the block walls are subjected to a differential pressure (DP) load of 0.261 psid (pounds per square inch differential). This is the peak pressure differential shown on the plot of Figure 1 in Attachment 1 (of Attachment 6 to the August 31, 2012, voluntary response), from a GOTHIC run of May 25, 2012, and it appears from the plot that the peak pressure buildup occurs within a fraction of a second (approximately 0.48 sec) of the initiation of the HELB event. Therefore, the Attachment 2 calculation appropriately uses a dynamic load factor (DLF) of 2.0 (which the licensee states is conservative because it has been compared to a DLF from a refined analysis of similar walls evaluated in Reference 11 of the calculation). According to the licensee, a seismic event concurrent with a HELB is part of the plant's design basis and, therefore, the calculation appropriately combines the DP load caused by a HELB with the load from the safe-shutdown earthquake (SSE). The calculation uses a masonry modulus of rupture (MOR) value of 250 psi, which is based on test data from the Clinton Power Station (CPS). The lower bound modulus of rupture provided in Byron and Braidwood's Updated Final Safety Analysis Report (UFSAR) Table 3.8-16 is 125 psi.

The NRC staff performed an independent review, using the peak DP load of 0.261 psi from Attachment 1 (of Attachment 6 to the August 31, 2012, voluntary response), of masonry wall and wall steel column data from Attachment 2 (including DLF of 2.0 and combining a SSE with a HELB) and the Byron and Braidwood's UFSAR MOR of 125 psi with a 1.5 factor of safety. The NRC staff did not use the CPS MOR value because it is not known whether the CPS value is applicable to the Braidwood and Byron Stations. The staff's independent review

shows that there is reasonable expectation of operability of the AB elevation 426'-0" ESF SWGR block walls and steel columns for the potential TB HELB DP load of 0.26 psi.

The NRC staff examined the GOTHIC file plot contained in Attachment 7 of the August 31, 2012, voluntary response, related to the SWGR DP. The plot shows that it takes approximately 100 sec for the HELB DP to start applying force to the SWGR block wall, 300 sec to reach 0.25 psid, 450 sec to reach 0.5 psid, and 750 sec to reach 0.66 psid. Because of the slow buildup of pressure on the wall, this DP loading of 0.66 psi can be considered static without requiring the application of a dynamic load factor. The NRC staff performed an independent review using a peak DP load of 0.66 psid, masonry wall and wall steel column data from Attachment 2, a DLF of 1.00, a combination of a SSE loading with a HELB DP loading, and the Byron and Braidwood Stations' UFSAR MOR of 125 psi with a factor of safety of 1.5. The staff's independent review shows that there is reasonable expectation that the AB elevation 426'-0" ESF SWGR block walls and steel columns will remain operable and functional.

The NRC staff performed an independent review of the ESF SWGR masonry block walls, including the supporting steel columns, for two loading conditions: (1) 0.261 psi dynamic pressure loading (DLF = 2.0) concurrent with an SSE and (2) 0.66 psi static pressure loading concurrent with an SSE. The NRC staff based its review on available information (as shown above) provided by the licensee in its voluntary response and in the licensee's corrective action document AR report No. 01427699. Based on the above and the NRC staff review described in Section D below (which confirms the GOTHIC models used to determine the 0.261 psi dynamic pressure loading and the 0.66 static pressure loading values were acceptable for the purpose of supporting the OEs), the NRC staff concludes that there is reasonable expectation of operability for the AB EL 426'-0" ESF SWGR unreinforced masonry block walls for DP loads from the examined postulated HELBs in the TB.

E. Use of the GOTHIC Code and the Subdivided Volume Feature

During the November 15, 2012, teleconference with the petitioner, the PRB requested that the petitioner provide the preliminary assessment using the subdivided volume feature in GOTHIC that showed that the structural limits on the block wall between the ESF SWGR rooms would be substantially exceeded as described in the petition. The petitioner agreed during the teleconference to provide the GOTHIC files he used to perform the preliminary modeling. During subsequent discussions with the Petition Manager, the petitioner stated he was still working on the model. Although the petitioner never provided the requested information, the NRC staff obtained the following information during an inspection of GOTHIC model activities on April 3, 2013 (ADAMS Accession No. ML13213A381).

Exelon performed two sets of analyses to support the then-current operability evaluation of Braidwood, Units 1 and 2, and Byron Unit, Nos. 1 and 2. The results of these analyses were submitted to NRC in Attachments 6 and 7 of the August 31, 2012, voluntary response to address the petition. Exelon was also performing a third analysis to address the petition and developing a GOTHIC model (fourth analysis) for the licensing basis analysis based on the modified plant configuration which was then in progress. The following paragraphs summarize information regarding these analyses obtained from discussion with Exelon.

The GOTHIC model for the first analysis used a subdivided approach for a HELB at the 426-feet elevation to perform structural evaluation of the safety-related switchgear walls. This analysis supported the then-current operability evaluation. Exelon presented its GOTHIC model diagram, subdivided volumes showing blockages, boundary conditions, initial conditions, and the output graphs. Exelon explained the HELB M&E release input used in the GOTHIC model and that M&E input is an important parameter that affects the results. Exelon explained that

the model considered M&E input from a realistic break scenario. This break scenario released less M&E than from an instantaneous double ended guillotine break (DEGB) of a large steam line. Exelon stated that a DEGB occurring instantaneously, or in a very small time on the order of one millisecond, is not a realistic break to be considered supporting the OE or a licensing basis analysis. Furthermore, Exelon stated that for such a break, which involves acoustic phenomena, the results would not be valid because of the limitations of GOTHIC code. The NRC staff reviewed the GOTHIC models for the first analysis and determined that the licensee had used generally accepted practices in developing the models. The NRC did not identify any unacceptable practices and, therefore, determined that the models were acceptable for the purposes of supporting the OEs.

The GOTHIC models for the second analysis used a lumped volume approach for HELB at the 401-feet, 426-feet, and 451-feet elevations. This analysis was used for structural evaluation of walls in safety-related and nonsafety related switchgear rooms, miscellaneous electrical equipment rooms, and cable spreading room walls. This analysis used the M&E input from a different scenario than used in the first analysis. The results of this analysis were also submitted to NRC in Exelon's August 31, 2012, voluntary submittal. The NRC staff reviewed the GOTHIC models for the second analysis and determined that the licensee had used generally accepted practices in developing the models. The NRC did not identify any unacceptable practices and, therefore, determined that they were acceptable for the purposes of supporting the OEs.

At the time it submitted the voluntary response to this petition in August 2012, Exelon was also developing GOTHIC models for two additional analyses (third and fourth analyses). In its third analysis, Exelon planned to use both subdivided and lumped approach as an "academic

exercise" to address the petition. This modeling work was not intended to address the OEs or a licensing basis analysis. Exelon did not present this analysis to the NRC staff in its August 31, 2012, voluntary submittal because at the time the analysis was incomplete. The NRC did not review these models in addressing this petition because they were not complete, they were not verified, and they were not being used to support OEs or a licensing basis analysis.

In August 2012, Exelon was also developing a GOTHIC model (fourth analysis) for the licensing basis analysis, based on the modified plant configuration without the need for OEs. At the time, Exelon had not decided whether it would use a subdivided or a lumped volume modeling approach. Exelon did not present this analysis to the NRC staff because at the time it was incomplete. These models were completed in July 2013, and were reviewed during the NRC's review of the license amendment request for Braidwood and Byron Stations' MUR uprate discussed in Section F, below.

F. High-Energy Line Break Licensing Basis

The fourth issue raised in the petition was that there has been no structured and detailed review of the licensing requirements for HELB. As indicated in Section II.A, above, at the time the petition was submitted, the NRC was aware of the then-current noncompliance with the licensing basis that resulted in the need for the OEs cited in the petition. In its August 2, 2012, request that the licensee provide a voluntary response to the petition, the NRC asked the licensee to address the extent-of-condition review of HELB areas other than the TB. In its August 31, 2012, response, the licensee stated that it was reviewing high-energy line cracks in the AB and that its current reviews did not identify HELB-related issues in areas other than the TB.

In a December 6, 2012 (ADAMS Accession No. ML12271A308), request for additional information related to the Braidwood and Byron Stations' MUR uprate LAR, the NRC staff requested that the licensee provide a summary of the results of its extent-of-condition review related to the HELB noncompliance. The licensee responded in a July 5, 2013, supplement to the LAR (ADAMS Accession No. ML13186A178), and concluded that the supporting HELB analyses for other plant structures containing high-energy lines that could impact safety-related equipment were not impacted by the nonconformances identified in the TB HELB analyses.

By letter dated November 13, 2013 (ADAMS Accession No. ML13318A232), the licensee confirmed that the physical modifications to restore the licensing basis for the TB HELB had been completed. As a result, the OEs referred to in the petition were no longer necessary.

NRC staff review of the licensing basis, and the licensee's compliance with the licensing basis, was accomplished during the review of the LAR for Braidwood and Byron Stations' MUR uprate. On February 7, 2014, the NRC staff issued Amendment No. 174 for Braidwood Station, Units 1 and 2, and Amendment No. 181 for Byron Station, Unit Nos. 1 and 2, to implement the MUR uprate (ADAMS Accession No. ML13281A000). Regarding the TB HELB analysis, the safety evaluation for the MUR amendments found that: (a) the licensee used an approved methodology for the TB HELB analysis, (b) the GOTHIC inputs and assumptions are conservative, (c) the output results of the GOTHIC models for the pressure, temperature, and humidity in the AB rooms to be used for EQ are limiting, and (d) the results of differential pressure analysis across the AB walls are limiting. Therefore, in the SE for the MUR amendments, the NRC staff concluded that the licensee had satisfactorily justified that the TB HELB analysis meets the current licensing basis.

III. Conclusion

Based on the above, NRR has decided to deny the petitioner's request to immediately shut down the Braidwood and Byron Station units. NRR has partially granted the petition in that NRR addressed the petitioner's fourth concern by evaluating the licensing basis requirements for HELB during the review of the LAR for the Braidwood and Byron Stations' MUR uprate. The results of that review are documented in the SE that was issued with the MUR uprate amendment on February 7, 2014.

With regard to the other concerns raised in the petition, the NRC staff has concluded that there was reasonable expectations of equipment operability for the following issues:

- EDG operability,
- High temperature in the ESF SWGR rooms, and
- Structural limits on the block wall between the ESF SWGR rooms.

As provided in 10 CFR 2.206(c), a copy of this director's decision will be filed with the Secretary of the Commission for the Commission to review. As provided by this regulation, the decision will constitute the final action of the Commission 25 days after the date of the decision unless the Commission, on its own motion, institutes a review of the decision within that time.

Dated at Rockville, Maryland, this 22nd day of December 2014.

FOR THE NUCLEAR REGULATORY COMMISSION

/RA/

William M. Dean, Director
Office of Nuclear Reactor Regulation